WEST

| Help | Logout | Interrupt |

| Main Menu | Search Form | Posting Counts | Show S Numbers | Edit S Numbers | Preferences | Cases |

Search Results -

Terms	Documents
l8 not L13	168

Database:

```
US Patents Full-Text Database
US Pre-Grant Publication Full-Text Database
JPO Abstracts Database
EPO Abstracts Database
Derwent World Patents Index
IBM Technical Disclosure Bulletins
```

Search: L14

Refine Search

Recall Text   Clear

Search History

DATE: **Tuesday, April 22, 2003**   Printable Copy   Create Case

Set Name side by side	Query	Hit Count	Set Name result set
DB=USPT,PGPB,JPAB,EPAB,DWPI,TDBD; PLUR=YES; OP=ADJ			
L14	l8 not L13	168	L14
L13	L12 and l8	12	L13
L12	L11 and l9 and l10	1014	L12
L11	wheel near slip	6800	L11
L10	vehicle near (speed or velocity)	62715	L10
L9	brake near pressure	20974	L9
L8	L7 not l4	180	L8
L7	L6 same (axle or axis)	184	L7
L6	L3 same l2 same l1	1723	L6
L5	L4 same (axle or axis)	1	L5
L4	L3 near l2 near l1	16	L4
L3	value or threshold or predetermined	3911116	L3
L2	traction	72934	L2
L1	slip$4	379283	L1

END OF SEARCH HISTORY

WEST

☐ | Generate Collection | | Print |

L13: Entry 4 of 12   File: USPT   Jan 19, 1999

DOCUMENT-IDENTIFIER: US 5862503 A
** See image for Certificate of Correction **
TITLE: System for driving stability control

Abstract Text (1):
Apparatus for improving the driving behavior of a vehicle is provided. The vehicle has
front and rear axles, each having a plurality of wheels. Each wheel-has a brake.
Sensor are provided for measuring the rotational speed of each wheel, the vehicle yaw
rate and the vehicle lateral acceleration. An anti-lock braking system provides first
preset pressure values for controlling each brake, to prevent the wheels from locking
during braking. A traction slip control system provides second preset pressure values
for controlling each brake, to prevent the wheels from slipping during acceleration. A
brake effort proportioning system provides third preset pressure values for
distributing braking pressure between the wheels of the front axle and the wheels of
the rear axle. A yawing moment controller provides fourth preset pressure values used
to control each brake during cornering, to avoid application to the vehicle of an
unbalanced moment which would cause the vehicle to understeer or oversteer. The
antilock braking system, traction slip control system, brake effort proportioning
means and yawing moment control system all operate independently of one another. A
prioritizing mechanism applies criteria to determine a desired brake pressure that is
applied to each wheel, based on the outputs of the antilack braking, traction slip
control, brake effort proportioning, and yawing moment control systems.

Brief Summary Text (6):
Consequently, a vehicle is defined in this connection as a motor vehicle with four
wheels, which is equipped with a hydraulic brake system. In a hydraulic brake system,
a brake pressure can be built up by the driver by means of a pedal-actuated main
cylinder. Each wheel has a brake, with which one inlet valve and one outlet valve each
is associated. The wheel brakes communicate with the main cylinder via the inlet
valves, while the outlet valves lead to a pressureless tank or to a low-pressure
accumulator. Finally, there also is an auxiliary pressure source, which is able to
build up a pressure in the wheel brakes regardless of the position of the brake pedal.
The inlet and outlet valves can be electromagnetically actuated for pressure
regulation in the wheel brakes.

Brief Summary Text (7):
To detect states in the dynamics of the vehicle movement, there are four speed
sensors, one per wheel, one yaw rate meter, one lateral acceleration meter, and at
least one pressure sensor for the brake pressure generated by the brake pedal. The
pressure sensor may be replaced with a pedal travel or pedal force meter if the
auxiliary pressure source is arranged such that a brake pressure built up by the
driver is not distinguishable from that of the auxiliary pressure source.

Brief Summary Text (19):
The present invention is a system in which the ABS, TSC, EBV and YMC controllers
develop brake pressure preset values (P.sub.ABS, P.sub.TSC, P.sub.EBV, and P.sub.YMC)
for the individual wheels on the basis of their own control strategies in parallel
with, and independently from, one another. The redundancy of the individual
controllers with their own control strategies consequently makes possible the
simultaneous calculation of preset values for the control, based on different
criteria. Consequently, the determination of all four preset values for the control
does not take longer than the time needed by the slowest controller. Slow refers here

to the calculation time for determining individual <u>brake pressure</u> preset values.

<u>Brief Summary Text</u> (20):
Different criteria may lead to different results with respect to necessary control interventions. According to another aspect of the invention, integration in a priority circuit, which compares the <u>brake pressure</u> preset values with one another and, if necessary, selects the <u>brake pressure</u> preset values of one of the controllers, or combines or mixes the preset values with one another in order to establish the actual control intervention, is provided.

<u>Drawing Description Text</u> (11):
FIG. 11 shows a schematic block diagram for determining the wheel <u>brake pressure,</u>

<u>Drawing Description Text</u> (22):
FIG. 26 shows a diagram for describing the lateral and longitudinal force coefficients as a function of the <u>wheel slip,</u>

<u>Detailed Description Text</u> (3):
The variables given by the driver, namely, the driver <u>brake pressure</u> Pbrake and the steering angle .beta., act on the vehicle 1. The variables resulting from this, namely, the motor moment M.sub.motor, the lateral acceleration a.sub.trans, the yaw rate .PSI., the wheel speeds and hydraulic signals, such as wheel <u>brake pressures,</u> are measured on the vehicle. To evaluate these data, the DSC system has four electronic controllers 7, 8, 9 and 10, which are associated with the anti-locking system ABS, the traction slip control system TSC, the electronic brake effort proportioning system EBV, and the yawing moment control system YMC, respectively. The electronic controllers for ABS 7, TSC 8 and EBV 9 may correspond to the state of the art without change.

<u>Detailed Description Text</u> (4):
The wheel speeds are sent to the controllers for the anti-locking system 7, the traction slip control system 8 and the electronic brake effort proportioning system 9. The controller 8 of the traction slip control system additionally receives data on the actual engine torque, the motor moment M.sub.Motor. This information is also sent to the controller 10 for the yawing moment control system YMC. In addition, controller 10 receives the data on the lateral acceleration atrans and the yaw rate .PSI. of the vehicle from the sensors. Since a vehicle reference velocity v.sub.Ref, on the basis of which an excess brake slip of one of the wheels can be determined, is determined in the controller 7 of the ABS via the individual wheel <u>speeds of the vehicle</u> wheels, such a reference velocity does not need to be calculated in the YMC controller 10, but it is taken over from the ABS controller 7. Whether the vehicle reference speed is calculated or a separate calculation is performed for the yawing moment control makes only a slight difference for the process of the yawing moment control. This also applies, e.g., to the longitudinal acceleration a.sub.long of the vehicle. The value for this also can be determined in the ABS controller 7, and sent to the YMC controller 10. This applies to the determination of the coefficient of friction .mu. of the road surface with restrictions only, because a more accurate coefficient of friction determination than is determined for the anti-locking system is desirable for yawing moment control.

<u>Detailed Description Text</u> (5):
All four electronic controllers of the DSC, i.e., the controllers for YMC 10, ABS 7, TSC 8 and EBV 9, develop <u>brake pressure</u> set values P.sub.YMC, P.sub.ARS, P.sub.TSC, P.sub.EBV for the individual wheels simultaneously and independently from one another based on their own control strategies.

<u>Detailed Description Text</u> (7):
The pressure preset values PYMc of the YMC controller 10 for the individual wheel <u>brake pressures</u> are determined as follows: The YMC controller 10 first calculates an additional yawing moment M.sub.G, which leads to stabilization of the driving condition within a curve if it is generated by a corresponding brake actuation. This M.sub.G is sent to a distribution logic unit 2, which could also be represented as part of the YMC controller 10. In addition, the possible desire of the driver to decelerate the vehicle, which is recognized from the driver <u>brake pressure</u> P.sub.brake, is also sent to this distribution logic unit 2. The distribution logic

unit 2 calculates yawing moment control brake pressures p.sub.YMC for the wheel brakes, which may differ from the preset yawing moment M.sub.G and the desired driver brake pressure very greatly for the individual wheels. These yawing moment control brake pressures P.sub.YMC are sent to a priority circuit 3 for the wheel brake pressures, for function optimization along with the pressure preset values calculated by the other controllers 7, 8 and 9 for ABS, TSC and EBV. This priority circuit 3 determines desired wheel pressures p.sub.Desired for optimal driving stability, taking into account the driver's desire. These desired pressures may either correspond to the pressure preset values of one of these four controllers, or represent a superimposition.

Detailed Description Text (8):
The procedure followed in the case of the engine torque is similar to the procedure with the wheel brake pressures. While ABS and EBV act only on the wheel brakes, intervention with the engine torque is also provided in the case of YMC and TSC. The preset values M.sub.AdjustM and M.sub.TSC calculated separately for the engine torque in the YMC controller 10 and in the TSC controller 8 are again evaluated in a priority circuit 4 and superimposed to a desired torque. However, this desired torque M.sub.Desired may also just as well correspond only to the calculated preset value of one of the two controllers.

Detailed Description Text (9):
Driving stability control by intervention with the brakes and the engine can now be performed based on the calculated desired preset values for the wheel brake pressure p.sub.Desired and for the engine torque M.sub.Desired. Hydraulic signals or values, which reflect the actual wheel brake pressure, are also sent for this purpose to the pressure control unit 5. From this, the pressure control unit 5 generates valve signals, which are sent to the control valves of the individual wheel brakes in the vehicle 1. The engine management controls the drive motor of the vehicle according to M.sub.Desired, as a result of which a changed motor moment is again generated. This will then again lead to new input variables for the four electronic controllers 7, 8, 9 and 10 of the DSC system.

Detailed Description Text (18):
To cut off peaks in the case of great variations in the side slip angles, the calculated value of velocity of the side slip angle passes through a first-order low-pass filter 15, which sends an estimated value .beta. for the velocity of the side slip angle to the activation logic unit 11 and to a program 16 for converting the yawing moment control law. Program 16 also uses the preset values for changing .DELTA..PSI. for the yaw rate, which is the difference of the measured yaw rate .PSI..sub.Meas and the desired yaw rate .PSI..sub.desired calculated on the basis of the vehicle reference model 12. The additional yawing moment M.sub.G for the vehicle, which is to be mediated via the brake pressures, is calculated from this.

Detailed Description Text (42):
The longitudinal acceleration a.sub.long can be recognized in different ways. It can be determined, e.g., from the reference velocity v.sub.Ref provided by the ABS controller 7, in which case it should be borne in mind that such a reference velocity v.sub.Ref may deviate from the actual vehicle velocity during an ABS intervention. Consequently, a correction of v.sub.Ref is justified in an ABS case. However, the longitudinal acceleration a.sub.long can also be taken over under certain circumstances directly from the ABS controller if such calculation is performed there.

Detailed Description Text (64):
The velocity of the side slip angle .beta. corresponding to the above differential equation can now be calculated. Besides the lateral acceleration a.sub.trans, the yaw rate .PSI., the scalar velocity of the vehicle v and its time derivative v are included as measured variables. To determine .beta., .beta. from the previous calculation can be numerically integrated, and v=0 is assumed for the first determination of .beta.. A simplification is obtained if the last term is generally ignored, so that no .beta. needs to be determined.

Detailed Description Text (94):
A so-called vehicle reference model 12 (FIG. 2)=302 (FIG. 9), which is supplied with

input data (velocity v, represented by v.sub.Ref, steering angle), is provided in the YMC controller 10. The size of the change in the yaw angle (yaw rate .PSI..sub.Desired) is calculated in the vehicle reference model 302 on the basis of the input data. The desired value of the yaw rate .PSI..sub.Desired is compared with the measured actual value of the yaw rate .PSI..sub.Meas in a downstream comparison unit 303. The comparison unit 303 sends as an output value an output variable .DELTA..PSI., which corresponds to the difference between .PSI..sub.Desired and .PSI..sub.Meas. The difference value thus determined is sent to a control law unit 16 for controlling the yawing moment. On the basis of .DELTA..PSI., the control law unit calculates an additional yawing moment M.sub.G, which is sent to the distribution logic unit 2. Based on the additional yawing moment M.sub.G and possibly the driver's desire to build up <u>pressure in the brakes,</u> p.sub.Brake, the distribution logic unit 2 sets output variables. These may be <u>brake pressure</u> values or valve switching times.

Detailed Description Text (99):
The switching over between the calculation models 306 and 311 is performed automatically by a change-over switch (not shown in the drawing) in the vehicle reference model 302 as a function of the <u>velocity of the vehicle</u>. A hysteresis of a few km/h is provided for switch-over processes from one model to the other. Below the switching threshold, the desired yaw rate .PSI..sub.Desired is calculated according to the model of stationary circular travel. If the velocity, increasing from a lower value, exceeds the threshold that applies to this direction, the calculation of the desired value of the yaw rate .PSI..sub.Desired is performed by means of the dynamic single-track model 311. The dynamic processes that are particularly important for control at higher velocities are thus incorporated in the model.

Detailed Description Text (118):
Based on the difference of the king pin inclinations, it is consequently possible to directly determine the instantaneous driving condition of the vehicle. If the single-track vehicle model (FIG. 12) is used as a hypothesis, the king pin inclinations can be derived from this as a function of the steering angle .delta., the side slip angle .beta., the yaw rate .PSI. and the <u>velocity of the vehicle</u> v, as follows: ##EQU15##

Detailed Description Text (128):
It is undesirable, e.g., for the control to always force the vehicle to the curve path predetermined by the steering angle .delta. when the steering wheel was turned in excessively or too rapidly in relation to the existing <u>velocity of the vehicle</u>.

Detailed Description Text (182):
In the case of hydraulic brakes, the task is therefore practically to set a <u>brake pressure</u> for every individual wheel brake. The moment to be obtained around the vertical axis shall be obtained with the lowest possible pressures in the individual brakes. It is therefore proposed that a coefficient be determined for each wheel and that the <u>brake pressures</u> be calculated from the vehicle yawing moment to be generated and the actual weighted coefficient.

Detailed Description Text (183):
As was explained above, it is favorable, especially in vehicle brake systems operating hydraulically, to determine the coefficients such that the <u>brake pressure</u> for the individual wheel brakes can be directly determined. The weighting of the coefficients is performed by dividing every individual coefficient by the sum of the squares of all coefficients.

Detailed Description Text (184):
Each coefficient determines the relationship between the wheel <u>brake pressure</u> and the individual wheel brake forces thus generated as a percentage of the yawing moment of the vehicle.

Detailed Description Text (196):
The method of calculation proposed has the advantage that the corresponding <u>brake pressures</u> can be calculated very rapidly from a predetermined additional yawing moment. Should the above-described parameters change during travel, this is taken into account via a change in the coefficients in the calculation of the <u>brake pressure</u>.

Detailed Description Text (212):
A coefficient c.sub.xx is calculated from the above-mentioned values for each wheel; the values 640, 641, 642, 643 may be calculated simultaneously or consecutively. The calculation is performed according to a function implemented in the program. The known relationships between the brake pressure and the brake force are taken into account in this function. The relationship is usually linear. Only the steering angle .delta. must be taken into account separately. How the steering angle can be taken into account in a suitable manner will be described below.

Detailed Description Text (214):
Calculating the individual pressures according to this formula offers the advantage that only relatively low pressures must be introduced into the wheel brakes to reach the calculated braking moment. Furthermore, the brake pressure control is able to respond very sensitively and rapidly to changes especially in the steering angle and in the coefficients of friction.

Detailed Description Text (224):
This procedure reaches a limit when a driving stability control is to be performed during pedal braking, i.e., when a certain brake pressure has already been set in the wheel brakes because of braking by the driver. The above-described procedure can be applied, in principle, to this case as well. Instead of absolute pressures, changes in the brake pressures already set are determined.

Detailed Description Text (225):
However, the following problems arise. If a very high pressure has already been introduced into a wheel brake, so that very high brake forces are reached, an increase in the brake pressure would not necessarily lead to an increase in the brake force, because the limit of adhesion between the tire and the road surface has been reached. The linear relationship between the brake pressure and the brake force, which was assumed in the above-mentioned model, is no longer present in this case.

Detailed Description Text (228):
The wheel brakes of at least one wheel are actuated such that the longitudinal slip 2 of the wheel is set such that it is greater than the longitudinal slip at which the maximum frictional connection is reached. This procedure is based on the fact that the brake force transmitted, i.e., the longitudinal force on the tire, reaches its maximum at a longitudinal slip of approx. 20% (0%=freely rolling wheel; 100%=locked wheel), and the brake force that can be transmitted decreases only slightly at values above 20%, so that there is no appreciable loss during the deceleration of the vehicle at wheel slips between 20% and 100%.

Detailed Description Text (229):
However, if the lateral force that can be transmitted, i.e., the force that acts at right angles to the wheel plane, is also taken into account at the same time, a strong dependence on wheel slip is seen, which is manifested in that the lateral force that can be transmitted greatly decreases with increasing slip. In the slip range above 50%, the wheel exhibits a behavior similar to that of a locked wheel, i.e., hardly any lateral forces are applied.

Detailed Description Text (233):
In addition, the pressure can be prevented from decreasing on one front wheel. This is done according to the following rules. In a driving situation in which the vehicle exhibits understeering behavior, the brake pressure is prevented from decreasing on the front wheel that is the outer wheel in the curve. The pressure is prevented from decreasing on the front wheel that is the inner wheel in the curve in a situation in which the vehicle exhibits oversteering behavior.

Detailed Description Text (234):
The actual control of the brake pressure may be performed as follows. As was explained before, the brake pressure in the individual wheel brakes is determined individually as a function of the yawing moment to be reached and the weighted wheel coefficients.

Detailed Description Text (237):
Based on weighted coefficients, the control program calculates the brake pressure that must be produced in every individual wheel brake. The calculation becomes more

problematic when the vehicle is braked, especially when it is being decelerated while utilizing the limit of frictional connection between the tire and the road surface. It is quite possible in such cases that an anti-locking control will first begin before a superimposed driving stability control becomes necessary.

Detailed Description Text (239):
Even though the same effect of generating an additional yawing moment can be produced by reducing the wheel brake pressure of the other wheel of the axle, this would cause, on the whole, a reduction in the braking force, which in turn conflicts with the requirement that the vehicle is to be stopped over the shortest possible distance.

Detailed Description Text (243):
FIGS. 27a,b show a schematic representation of a vehicle in a right curve. Corresponding to the radius of the curve and the velocity of the vehicle, the vehicle must turn around its vertical axis, i.e., there must be a defined clockwise yaw rate.

Detailed Description Text (245):
If the measured yaw rate deviates from the yaw rate to be reached to such an extent that the vehicle does not turn sufficiently, a so-called understeering behavior is present. An additional moment, which is counted as negative in this situation, must be applied. It shall cause the vehicle to turn into the curve. This could be achieved in this case by increasing the brake pressure in the right-hand wheels of the vehicle.

Detailed Description Text (250):
These coefficients are a function of parameters that describe the vehicle or the wheel brakes, and of variables which change during travel. These are especially the steering angle .delta. and the coefficient of friction .mu. for the road/tire pairing (cf. Section 3.1.). A dependence on the longitudinal slip of the corresponding wheel is now additionally introduced for the above-mentioned control. The pressure on individual wheels can be prevented from decreasing by defining lower limits for the coefficients, replacing the calculated value of the coefficients with the minimum if the actual value drops below the minimum.

Detailed Description Text (251):
A corresponding algorithm is shown in FIG. 28. The additional yawing moment M.sub.G is first calculated (program 640). The corresponding changes in the brake force and in the brake pressure are calculated from this moment for the individual wheels (program part 641). The brake pressures determined are compared with thresholds p.sub.th, which are determined, among other things, by the road/tire coefficient of friction pairing (block 642). The thresholds p.sub.th determine whether a further increase in the wheel brake pressure with a simultaneous increase in brake force is possible. If the pressures to be introduced remain below these limit values, the control is performed according to the procedure mentioned in Section 3.1. If the calculated brake pressures are above these threshold values, the pressures are calculated according to the scheme 644 described above.

Detailed Description Text (254):
Based on these pressure values, control signals for inlet and outlet valves are sent by a subordinate pressure control circuit. The actual wheel brake pressures are harmonized with the calculated ones in this subordinate pressure control circuit.

Detailed Description Text (270):
Consequently, brake pressures are not calculated or set at any point of the control circuit. Therefore, the control algorithms need no information on the wheel brake, and, in particular, no information on the relationship between the volume received by the wheel brakes and the resulting brake pressures.

Detailed Description Text (272):
Brake pressures, which are to be built up in the individual wheel brakes, are calculated from the additional yawing moment M.sub.G via the distribution logic unit 700. How this is done can be found described in Sections 3.1. and 3.2. As a result of the calculation within the distribution logic unit, there are four pressure values p.sub.1 through p.sub.4 for a four-wheel vehicle. These variables must be converted into switching times for the valves, which control the feed of pressure medium (pressure build-up) and the release of the pressure medium (pressure reduction) and

from the wheel brakes.

Detailed Description Text (274):
The current pressure requirement is read from the first register place 702 in the next
step 705. If this value is 0 or lower than a minimum, the program branches into a loop
706, with which it shall be ensured that so much pressure medium is removed from the
wheel brake that the pressure becoming established becomes zero. To do so, the inlet
valve is closed and the outlet valve is opened for at least one loop time $T.sub.0$.

Detailed Description Text (286):
It is therefore necessary to adjust the actual pressure in the wheel brake to the
pressure requirements in certain situations. This can be done in the simplest manner
when the pressure requirement is zero, i.e., the distribution logic unit 700 requires
a value that corresponds to the pressure zero in a wheel brake. The difference from
the preceding value is not formed, and the control signals are not derived from this
in such a case, but it is branched off in step 705 into the loop 706 for calculating
the switching times, and this loop is to ensure that a pressure value of zero is
indeed set. This is done by setting the switching time $.DELTA.t.sub.out$ for the outlet
valve to at least the loop time $T.sub.0$. It may also become necessary to send
corresponding information to the priority circuit 720, so that this time requirement,
which is to lead to zero pressure in a wheel brake, will not be superimposed by preset
values of the other controllers. In addition, it can be determined in this information
that the reduction in pressure shall take place over several loop times, so that it is
ensured that a complete pressure reduction will indeed take place.

Detailed Description Text (287):
6. Wheel Brake Pressure Recognition

Detailed Description Text (288):
The DSC pressure controller described up to Section 4 provides brake pressure values
for the wheel brakes as a result. These preset values must be put into practice. One
method is to measure the pressures in the wheel brakes and to compare them with the
preset values. A pressure controller that operates according to the usual laws adjusts
the wheel brake pressure to the predetermined desired value.

Detailed Description Text (295):
The real vehicle responds to the brake pressures introduced, and a certain velocity v
of the center of gravity and wheel speeds $.omega..sub.i$ of the individual wheels will
become established. The velocity of the vehicle is not directly measured, but it is
also derived from the speeds $.omega..sub.i$ of the individual wheels in special
calculation steps. They are therefore called the reference velocity $v.sub.Ref$.

Detailed Description Text (297):
A correcting variable for the pressure in the individual wheel brakes can be
determined from a comparison of the actual values of $.omega..sub.i$, $v.sub.Ref$ with the
calculated values of $.omega..sub.i$ and $v.sub.Ref$ or on the basis of the values of
$.omega..sub.i$ and $v.sub.Ref$ estimated on the basis of the vehicle model, and a
pressure calculated via a hydraulic model can be modified by means of the correcting
variable, so that a better estimate of the wheel brake pressures can be given.

Detailed Description Text (300):
An evaluation unit $.omega..sub.i$ also belongs to the vehicle 810; this evaluation unit
usually represents a partial area of an ABS controller, which calculates a so-called
reference velocity $v.sub.Ref$, which is to correspond to the actual velocity of the
vehicle, from the wheel speeds $.omega..sub.i$ of the individual wheels under certain
boundary conditions.

Detailed Description Text (301):
A slip $.lambda..sub.i$ can be calculated for each wheel from the individual wheel
speeds and the vehicle reference velocity.

Detailed Description Text (307):
In two approximation formulas, the hydraulic model 821 describes the relationship
between the brake pressure p and the volume V enclosed in the wheel brake, and the
change $.DELTA.V$ in volume when the inlet or outlet valve is opened for a certain time.

Detailed Description Text (318):
The decelerating torques acting on the wheel are determined linearly from the wheel brake pressure.

Detailed Description Text (319):
It is assumed in the tire model that the utilization of the frictional connection, f, namely, the ratio of the braking force to the wheel load, changes linearly with the slip of the wheel.

Detailed Description Text (320):
The equations given make it possible to calculate the wheel speed of each wheel and the reference velocity of the vehicle model.

Detailed Description Text (323):
This additional pressure medium volume .DELTA.V is added to the calculated desired volume to obtain the new desired volume, from which a wheel brake pressure, which corresponds to the actual wheel brake pressure relatively accurately, can be derived according to formula 6.1.

Detailed Description Text (337):
As is apparent from FIG. 15, l.sub.v, l.sub.h are the distances between the respective lateral. acceleration meters 322, 323, on the one hand, and the center of gravity SP, on the other hand, while v is the velocity of the vehicle, and .beta. is the side slip angle. The yaw acceleration g.sub.I can thus be determined from the lateral accelerations and the distances of the acceleration meters 322, 323.

Detailed Description Text (350):
The distribution logic unit 2 has a logic block 340 and a pressure gradient circuit 341. The essential task of the logic block 340 is to ensure that despite the intervention of the driving stability control, the vehicle as a whole is not braked more strongly than is desired by the driver by presetting a pressure signal at the input of the distribution logic unit 2. This is to prevent instabilities from being additionally introduced by the driving stability control system. Consequently, when a brake pressure is provided on a wheel based on the driver's desire to brake, and, on the other hand, a pressure build-up on one or two wheels is required via the DSC controller and a reduction in pressure on the opposite wheels is required in order to reach the additional yawing moment, there may be mutually contradictory requirements with respect to the individual wheels, namely, a pressure build-up with a simultaneous reduction in pressure. Regarding other wheels, it may be required to increase the pressure not only based on the driver's desire to brake, but at the same time also based on the stability control. The logic block ensures that the brake pressure is first reduced in the corresponding wheels, after which an increase in brake pressure beyond the driver's desire up to a certain limit value can take place. It is thus ensured that the average brake force will not become greater, considering all wheels and taking the additional torque brought about by the DSC control into account, than that desired by the driver.

Detailed Description Text (352):
The changes in pressure .DELTA.P.sub.xx on the individual wheels xx are calculated in the pressure gradient circuit 341 of the distribution logic unit 2 on the basis of predetermined constants c.sub.xx and the change in moment M, and the difference between the brake pressure desired by the driver, P.sub.Brake, and the brake pressure actually measured, P.sub.xxist, is also included in the calculation. Thus, the following equation applies ##EQU29## and g.sub.I =proportionality factor.

Detailed Description Text (353):
The actual brake pressure p.sub.xxist is determined either by a pressure gauge at the corresponding wheel, or it is calculated via a brake model, which follows the changes in pressure specified for the wheel and is therefore an image of the pressure occurring on the wheel (Section 6). The pressure requirements calculated are sent to a priority circuit 3 and they are evaluated there (See section 4, above).

Detailed Description Text (354):

The above description presupposes that pressure gradients were directly processed in the priority circuit. However, this is not necessary. It is also possible to process valve switching times .DELTA.t in the priority circuit 3 (Section 5). However, a valve switching time circuit 343 must be inserted in this case between the distribution logic unit 2 and the priority circuit 3, and valve switching times .DELTA.t will be sent by the other controllers 7, 8, 9 as well. The priority circuit now processes the valve switching times .DELTA.t entered according to a corresponding scheme, as was described in Section 4 for the brake pressures. The output variables of the priority circuit are valve switching times. The required changes in pressure .DELTA.t.sub.xx of the individual wheels xx are converted into valve switching times .DELTA.p according to the equation

CLAIMS:

6. Yaw moment control apparatus for improving the driving behavior of an automotive vehicle, the vehicle including means for determining a vehicle velocity, a vehicle steering angle, a measured yaw rate, and a vehicle lateral acceleration, said apparatus comprising:

yaw control means for generating a value representing a desired yaw rate adjustment based on the vehicle steering angle, the vehicle velocity and the measured yaw rate;

means for calculating an estimated coefficient of friction based on the vehicle velocity, the lateral acceleration, the measured yaw rate and the steering angle, said estimated coefficient of friction being used by the yaw control means for determining the desired yaw rate adjustment only while the vehicle is traveling through a curve.

8. In a yaw control system of a vehicle having a plurality of wheel brakes, a method for determining pressure adjustments for the brakes, individually, and applying the pressure adjustments to adjust a yawing moment that is applied to the vehicle by the brakes, comprising the steps of:

(1) detecting a condition in which an increase in the brake pressure applied to a first one of the brakes is required to apply the yawing moment to the vehicle while a driver of the vehicle is actuating the brakes to apply a first braking force to the vehicle;

(2) determining a reduction in pressure that is applied to a second one of the brakes; and

(3) reducing pressure in the second brake before initiating the increase in the pressure applied to the first brake.

WEST

☐ | Generate Collection | | Print |

L13: Entry 1 of 12   File: PGPB   Apr 18, 2002

DOCUMENT-IDENTIFIER: US 20020043875 A1
TITLE: METHOD AND DEVICE FOR MONITORING A BRAKING SYSTEM CONTAINED IN A VEHICLE

Summary of Invention Paragraph (2):
[0001] International Patent Publication No. WO 97/21570 describes a conventional braking system. This conventional braking system has a master brake cylinder, to which wheel brake cylinders are connected via wheel-brake pressure-modulation valve arrangements having a brake-pressure build-up valve and a brake-pressure reducing valve. Brake fluid released from the wheel brake cylinders through the brake-pressure reducing valves can be delivered by a return pump back in the direction of the master brake cylinder, or in the direction of the wheel brake cylinders again for renewed pressure build-up. A precharging pump is used to feed brake fluid from a reservoir to the return pump when the master brake cylinder is not actuated. Given appropriate switching of valves in the known vehicle braking system, brake pressure can be built up in the vehicle braking system both by the return pump and by the precharging pump. Furthermore, for slip control, this vehicle braking system has wheel-rotation sensors, as well as an electronic controller which evaluates signals from the wheel-rotation sensors and controls the pumps and valves of the vehicle braking system. This conventional vehicle braking system has a brake-slip control, traction-control, and an operating-dynamics control device.

Summary of Invention Paragraph (5):
[0004] German Patent Application No. 39 22 947 describes a hydraulic braking system which contains brake-pressure modulators that make it possible to prevent the vehicle wheels from locking as a result of brake pressures which are too high. The brake-pressure modulators include brake-line lock valves and cylinders having pistons, in response to whose displacement, pressurized media escapes from the wheel brakes to reduce the brake pressure. The piston displacements are controlled via valve configurations which are connected to a servo pressure source. Failure of the servo pressure source, if there is even a small leak of a valve arrangement, can lead to at least partial loss of braking force during a braking operation. To detect and indicate possibly existing leakiness, a control unit, acting on the valve arrangements, is adjusted, such that it controls the valve arrangements into different positions, and at the same time, observes via a pressure sensor whether logically assigned pressures are changing unacceptably. This conventional braking system also has the disadvantage that pressure sensors are necessary to implement the monitoring. It may be that it is possible to monitor the braking system independently of the driver, however the braking medium necessary for this is made available starting from a storage reservoir. Because of this, a constant pressure of the braking medium is not absolutely ensured, which can possibly lead to an impairment of the implemented monitoring.

Summary of Invention Paragraph (12):
[0010] Since the braking system is monitored as a function of a wheel-performance variable, the method according to the present invention therefore advantageously proceeds during predetermined vehicle states. This ensures that the wheel-performance variable, and with this variable the monitoring or checking of the braking system as well, is not invalidated by the vehicle performance. For example, the wheel-performance variable could be invalidated in response to cornering, or during an acceleration or braking process. To avoid this, the predetermined vehicle states are can be defined as follows: A predetermined vehicle state exists when the vehicle is traveling approximately straight ahead (e.g., in a straight line), and a variable describing the vehicle velocity is nearly constant, i.e., the vehicle is being neither

braked nor accelerated, and the master brake cylinder is not actuated. Actuation of the master brake cylinder can be ascertained, e.g. with the aid of a brake lights switch. Such vehicle states can be brought about either intentionally, or can arise during the operation of the vehicle, i.e., during normal vehicle operation. As an example, the control at the rear end of the assembly line at the vehicle manufacturer, during which the vehicle is either moved by a driver according to defined stipulations or the vehicle is on a roller dynamometer, or a test drive after being in a service garage, could be named as intentionally caused vehicle states.

Summary of Invention Paragraph (14):
[0012] All the intake valves can be brought by the predefined driving signals into a blocking position during this check test. During this driving of the intake valves, braking medium is conveyed toward the intake valves by actuating the pump. If the intake valves are in perfect condition, i.e. if in the blocking position, they in each case completely close off the associated wheel brake cylinder, then the brake pressure in the respective associated wheel brake cylinder cannot increase. On the other hand, if the intake valves do not completely close, then the brake pressure in the respective associated wheel brake cylinder will increase, which leads to a change in the associated wheel-performance variable. To better be able to ascertain the increase in brake pressure because of a defective intake valve, all the second valves of the first valve configurations, e.g., all discharge valves, can be also brought by the predefined driving signals into a blocking position. This ensures that the braking medium, which has flowed into the wheel brake cylinder, does not immediately flow out of the wheel brake cylinder again.

Summary of Invention Paragraph (15):
[0013] The check test for the first fault can be performed as follows: During the appropriate driving of the first and second valves of the first valve configurations, a wheel-performance variable is ascertained for each wheel. These wheel-performance variables are compared to a threshold value. If all the wheel-performance variables are less than the threshold value, which is synonymous with the brake pressure not having risen in the wheel brake cylinders, and the intake valves therefore being impervious, then the first fault is not present. In the event that at least one of the wheel-performance variables is greater than the threshold value, which is an indication that the first fault seems to be present, the driving of the pump and of the first and second valves is stopped.

Summary of Invention Paragraph (19):
[0017] Since the intention during this check test is to ascertain whether the wheel brake cylinders are correctly connected to the hydraulic modulator, i.e., the braking system, or whether the wheel r.p.m. sensors are correctly connected to the controller, to this end, for a first valve configuration, the predefined driving signals advantageously bring the first valve into a flow-through position and the associated second valve into a blocking position, and for the remaining first valve configurations, the first valves are brought into a blocking position, and the associated second valves are brought into a blocking position or a flow-through position. During the above-described driving of the first and second valves, braking medium is conveyed in the direction of the wheel brake cylinders by actuating the pump. Due to the above-described driving, one wheel brake cylinder is acted upon by the brake pressure built up by the pump, however the brake pressure does not act on the remaining wheel brake cylinders. Preferably, the discharge valves of these remaining wheel brake cylinders are open, to ensure that the brake pressure does not act on these wheel brake cylinders. The one wheel brake cylinder is acted upon by a brake pressure which is sufficient to bring about a noticeable change in the wheel-performance variable of the corresponding vehicle wheel, i.e., the r.p.m. or velocity of this vehicle wheel decreases significantly. No build-up in brake pressure can take place in the case of the remaining wheel brake cylinders, and thus no change can occur in the wheel-performance variable either.

Summary of Invention Paragraph (22):
[0020] The check test for the second fault can also be performed in such a way that, in each case, the associated first valve is brought appropriately into the flow-through position for a different wheel, one after the other. In other words, the check test for the second fault is performed so that, due to the cyclical driving of the first valve configurations, the brake pressure can act upon each vehicle wheel one

time during a test cycle. In so doing, sufficient time is provided in each case after the cyclical driving, so that the <u>brake pressure</u> of the respective wheel acted upon with pressure can again normalize.

Summary of Invention Paragraph (25):
[0023] The method according to the present. invention can be implemented on single-circuit braking systems, just as on multiple-circuit braking systems. This method can also be implemented for hydraulic and for pneumatic braking systems. Furthermore, the method according to the present invention can be implemented for electrohydraulic or electropneumatic braking systems, in which the <u>brake pressure</u> is not built up by a master brake cylinder, but by a pump or by a compressor, and is controlled as a function of a brake-force signal caused by a brake pedal. The method according to the present invention can also be implemented in the case of multiple-circuit braking systems having a precharging pump for each brake circuit.

Detail Description Paragraph (4):
[0032] Master brake cylinder 14 is designed, in a conventional manner, as a dual-circuit master brake cylinder. Master brake cylinder 14 has a first "rod piston" 36 which is moved directly by brake pedal 30 via power brake unit 32. In response to its displacement into master brake cylinder 14, rod piston 36 causes a build-up of <u>brake pressure</u> in a first pressure chamber 38 of master brake cylinder 14. In addition, master brake cylinder 14 has a second "floating piston" 40 which is acted upon by the pressure in first pressure chamber 38 and is thereby shifted in master brake cylinder 14 and, in response to its displacement into master brake cylinder 14, produces a <u>brake pressure</u> in a second pressure chamber 42 of master brake cylinder 14. The two pistons 36, 40 are indicated in the drawing by dotted lines. If, because of a defect, no <u>brake pressure</u> is built up in first pressure chamber 38 in response to the shift of rod piston 36 into master brake cylinder 14, rod piston 36, after a free travel, mechanically shifts floating piston 40 in a conventional manner, so that <u>brake pressure</u> is built up in second pressure chamber 42 by stepping down on brake pedal 30.

Detail Description Paragraph (9):
[0037] On an intake side of return pump 66, a pressure accumulator 74 is connected to feedback line 60. In feedback line 60, a check valve 76, traversable by flow in the direction of return pump 66, is arranged between pressure accumulator 74 and the intake side of return pump 66. A damper chamber 78 is disposed in feedback line 60 between a delivery side of return pump 66 and main brake line 44. An intake line 80 is connected directly to master brake cylinder 14 via main brake line 44, thus bypassing switch-over valve 48, a suction valve 82, closed in its basic position (e.g., blocking position), being arranged in intake line 80. The suction valve represents a second valve on the intake side. Intake line 80 leads to the intake side of return pump 66. Intake line 80 is used to feed brake fluid under pressure to return pump 66 in the event master brake cylinder 14 is not actuated, in order to achieve rapid <u>brake-pressure</u> build-up, even when working with cold, viscous brake fluid. The pressure is built up by a first pump (e.g., a precharging pump) 84 which is able to be driven by a separate electromotor 86, is connected to brake-fluid reservoir 28 of master brake cylinder 14 and delivers the brake fluid via a check valve 88 into main brake line 44 of a brake circuit I, with main brake line 44 being connected to first pressure chamber 38 of master brake cylinder 14. Precharging pump 84 acts with pressure upon first pressure chamber 38. In the event master brake cylinder 14 is not actuated, first pressure chamber 38 communicates via a restrictor, not shown in FIG. 1, with reservoir 28.

Detail Description Paragraph (10):
[0038] In master brake cylinders 14, the restrictor is formed by a central valve in rod piston 36, or a snifting bore hole, not shown in FIG. 1, in the connection of first pressure chamber 38 to reservoir 28. Thus, when master brake cylinder 14 is not actuated, precharging pump 84 conveys brake fluid in the circuit from reservoir 28 into first pressure chamber 38 and via the restrictor back into reservoir 28. Because of the restrictor, a pressure build-up takes place in first pressure chamber 38, and thus in main brake line 44. Because pressure acts upon first pressure chamber 38, pressure also acts upon second pressure chamber 42 via floating piston 40 of master brake cylinder 14, so that a pressure build-up also takes place in second brake circuit II. Given a closed switch-over valve 48 and an open (flow-through position)

suction valve 82, as a result of the pressure build-up by precharging pump 84, a portion of the brake fluid delivered by precharging pump 84 flows to the intake side of return pump 66, in order to effect the rapid brake-pressure build-up by return pump 66.

Detail Description Paragraph (14):
[0042] To determine whether the vehicle is in a predetermined state, a variable vf describing the vehicle velocity is ascertained in a conventional manner in block 202 as a function of wheel r.p.m. variables nij. With the aid of variable vf, it is determined whether the vehicle velocity is nearly constant. For example, the change of variable vf over time is determined and is compared to a corresponding threshold value. It is simultaneously ascertained in block 202 whether the vehicle is traveling approximately straight. To detect this straight-line travel, there are various possibilities as a function of the slip control carried out by block 204, which represents the controller core. For example, the difference between the wheel r.p.m. variables of wheels having the same axle is determined, in particular the front wheels. To determine whether the vehicle is traveling straight, the difference is compared to a corresponding threshold value. However, in this case, an additional logic is necessary for monitoring the wheel r.p.m. sensors, in order to detect or rule out possible errors which can originate from the wheel r.p.m. sensors. This detection of straight-line travel presents itself primarily when a brake-slip and/or traction control is being carried out in the controller core. Alternatively, and above all when an operating-dynamics control is being carried out by the controller core, and thus the relevant sensor 26 is available, a steering-angle signal delta and/or a transversal-acceleration signal aq and/or a yaw-rate signal omega can be evaluated to ascertain the straight-line travel. This is shown in FIG. 2 by the dotted-line representation and link of block 26 to block 202. A predetermined vehicle state exists when the vehicle velocity is nearly constant, and the vehicle is traveling approximately straight ahead. It can also be required that the master brake cylinder not be actuated.

Detail Description Paragraph (19):
[0047] Subsequently to step 302, a step 303 is carried out. In this step, wheel-slip variables lambdaij are ascertained in known manner for the vehicle wheels, on the basis of wheel r.p.m. variables nij and variable vf. Following step 303, a step 304 is executed, in which wheel-slip variables lambdaij are compared to a threshold value S. If it is determined in step 304 that one of wheel-slip variables lambdaij is greater than threshold value S, which is synonymous with an intake valve being defectively open, then, subsequently to step 304, a step 305 is carried out. If, on the other hand, it is determined in step 304 that no wheel-slip variable is greater than the threshold value, which is synonymous with all the intake valves being perfect, then, subsequently to step 304, a step 308 is executed. Therefore, in step 308, the value FALSE is assigned to variable F1. Following step 308 is a step 309, which terminates the check test for the first fault. In step 305, first the driving initiated in step 302 is broken off. After a predefined period of time, pump 66 and/or pump 84, as well as valves 48, 54, 56, 62, 64 and 82 are driven once more in accordance with step 302. In addition, wheel-slip variables lambdaij are ascertained once again. Subsequently to step 305, a step 306 is carried out. In this step, wheel-slip variables lambdaij are compared once again to a corresponding threshold value, as has already taken place in step 304. If it is determined in step 306 that one of wheel-slip variables lambdaij is greater than threshold value S, then subsequently to step 304, a step 307 is executed. Since at least one of the intake valves is defective, in this step, the value TRUE is assigned to variable F1. Following step 307, step 309 is carried out. If, on the other hand, it is determined in step 306 that no wheel-slip variable is greater than the threshold value, then subsequently to step 306, step 308 is executed.

CLAIMS:

5. The method according to claim 1, wherein, during step (c), the predetermined vehicle states are present when the vehicle is traveling in an approximately straight path and when a velocity variable indicating a velocity of the vehicle is substantially constant.

WEST

☐ | Generate Collection | | Print |

L4: Entry 2 of 16   File: USPT   Jul 4, 2000

DOCUMENT-IDENTIFIER: US 6082834 A
TITLE: Circuit arrangement for a brake system with anti-lock control and traction slip control

Brief Summary Text (8):
It has been discovered that this object may be achieved by the circuit arrangement of the present invention. The special features of the circuit arrangement of the present invention are that the hydraulic pump, in the BASR mode, is activated by a pulse train at least temporarily (there is a permanent activation in the beginning and in certain situations), that the flow rate of the pump is adjusted to the requirements in the respective situation and under the prevailing conditions by modulation of the pulse train, and that the requirements are determined by analyzing the traction slip of the driven wheels and the instantaneous rotational speed of the hydraulic pump. Expediently, the exceeding of predetermined traction slip thresholds is determined and analyzed as a standard of the required flow rate of the pump. The wheel slip data are required for the ABS control and BASR control anyway, so that this type of determination of requirements may be achieved without additional effort or, at the most, with little additional effort.

CLAIMS:

2. A circuit arrangement as claimed in claim 1, characterized in that the exceeding of predetermined traction slip thresholds is discovered and analyzed as a standard of the required pump flow rate.

3. A circuit arrangement as claimed in claim 1, characterized in that the exceeding of predetermined traction slip threshold values and one or more predetermined threshold values of the rotational pump speed is analyzed as a standard of the required pump flow rate and for adjusting the activation pulse train.

5. A circuit arrangement as claimed in claim 4, characterized in that several pulse patterns are formed by pulse trains with predetermined pulse times and ties of pulse break, and in that the pump motor is activated by a predetermined pulse pattern in response to at least one of: (1) the combination of the traction slip of the driven wheels and the instantaneous rotational speed of the hydraulic pump; or (2) the exceeding or falling short of the threshold values of traction slip and rotational motor speed.

6. A circuit arrangement as claimed in claim 5, characterized in that the traction slip is determined by comparing the speed of the driven wheels with the vehicle speed or the vehicle reference speed and is compared individually for each wheel with two predetermined traction slip threshold values, and in that these traction slip threshold values and a threshold value of the rotational motor speed serve to determine the respective pulse pattern for the pump activation, while at least one of the exceeding and falling short of the slip threshold values and the attaining of the rotational speed threshold value is analyzed in response to the pump activation.

11. A circuit arrangement according to claim 10 wherein said electronic circuit means determine when the traction slip of the driven wheels exceeds predetermined traction slip thresholds.

12. A circuit arrangement according to claim 10 wherein said electronic circuit means:

(a) determine when the traction slip of the driven wheels exceeds predetermined traction slip thresholds, and

(b) develop a standard of the required pump flow rate and select the timing signals in response to:

(1) the determination that the traction slip of the driven wheels exceeds predetermined traction slip thresholds, and

(2) at least one predetermined threshold of the rotational pump speed.

13. A circuit arrangement according to claim 10 wherein the timing signals have variable on times and off times and the ratio of the on time of the timing signals to the off time of the timing signals is selected in response to predetermined thresholds of the traction slip and the rotational speed of said hydraulic pump.

15. A circuit arrangement according to claim 14 wherein:

(a) the traction slip is determined by comparing the speed of the driven wheels with at least one of the vehicle speed and the vehicle reference speed; and

(b) the traction slip is compared individually for each wheel with two predetermined traction slip thresholds;

(c) the traction slip thresholds and a threshold of the rotational motor speed serve to select the timing pattern for activation of said hydraulic pump; and

(d) exceeding and falling short of the slip thresholds and attaining the threshold of the rotational speed of said hydraulic pump is analyzed in response to activation of said hydraulic pump.

WEST

☐ | Generate Collection | | Print |

L4: Entry 3 of 16   File: USPT   Nov 9, 1999

DOCUMENT-IDENTIFIER: US 5980000 A
TITLE: Circuitry for a brake system with traction slip control by brake management

Brief Summary Text (6):
German patent No. 37 41 247 discloses conforming the slip threshold values for a
traction slip control system to the tires of an automotive vehicle.

Brief Summary Text (13):
In a preferred aspect of the present invention, the traction slip control threshold of
the controlled wheel is raised (beyond a basic threshold) by way of the correction
factor as long as the traction slip of the non-controlled wheel is in excess of a
predetermined traction slip threshold, and is lowered until the basic threshold is
reached as long as the traction slip of the non-controlled wheel is below the
predetermined threshold.

Brief Summary Text (15):
and the first component f.sub.1 (t) of this correction factor, as long as the traction
slip of the non-controlled wheel exceeds a predetermined threshold, raises the control
threshold, and the second component f.sub.2 (t) lowers the control threshold until the
basic threshold is reached, as long as the traction slip of the non-controlled wheel
is below the predetermined traction slip threshold and f.sub.CORRECTION >0.

CLAIMS:

2. Circuitry as claimed in claim 1, characterized in that the traction slip control
threshold of the controlled wheel is raised beyond a basic threshold by the correction
factor as long as the traction slip of the second, non-controlled wheel of this axle
is in excess of a predetermined traction slip threshold, and is reduced until the
basic threshold is reached as long as the traction slip of the non-controlled wheel is
below the predetermined traction slip threshold.

3. Circuitry as claimed in claim 2, characterized in that the correction factor is
produced pursuant the relation

f.sub.CORRECTION1 =f.sub.1 (t)-f.sub.2 (t),

and includes a first component f.sub.1 (t) which, as long as the traction slip of the
non-controlled wheel exceeds a predetermined traction slip threshold, raises the
control threshold, and a second component f.sub.2 (t) which, as long as the traction
slip of the non-controlled wheel is below the predetermined traction slip threshold,
lowers the control threshold until the basic threshold is reached.

7. Circuitry according to claim 6 wherein the traction slip control threshold of the
first wheel is:

(a) raised by the correction factor beyond a basic threshold as long as the traction
slip of the second wheel is in excess of a predetermined traction slip threshold, and

(b) reduced by the correction factor until the basic threshold is reached as long as
the traction slip of the second wheel is below the predetermine traction slip
threshold.

8. Circuitry according to claim 7 wherein the correction factor is produced pursuant the relation

$$f_{CORRECTION1} = f_1(t) - f_2(t),$$

and includes:

(a) a first $f_1(t)$ component which, as long as the traction slip of the second wheel exceeds a <u>predetermined traction slip</u> threshold, raises the control threshold, and

(b) a second $f_2(t)$ component which, as long as the traction slip of the second wheel is below the <u>predetermined traction slip</u> threshold, lowers the control threshold until the basic threshold is reached.

WEST

End of Result Set

☐ | Generate Collection | | Print |

L5: Entry 1 of 1   File: USPT   Nov 9, 1999

DOCUMENT-IDENTIFIER: US 5980000 A
TITLE: Circuitry for a brake system with traction slip control by brake management

CLAIMS:

2. Circuitry as claimed in claim 1, characterized in that the traction slip control threshold of the controlled wheel is raised beyond a basic threshold by the correction factor as long as the traction slip of the second, non-controlled wheel of this axle is in excess of a predetermined traction slip threshold, and is reduced until the basic threshold is reached as long as the traction slip of the non-controlled wheel is below the predetermined traction slip threshold.

WEST

☐ | Generate Collection | | Print |

L4: Entry 8 of 16   File: USPT   Jul 12, 1994

DOCUMENT-IDENTIFIER: US 5329453 A
TITLE: Traction control system for automotive vehicle

Detailed Description Text (8):
The control unit 100 is so arranged as to receive the output signals Sa, Sd and Sv in
a predetermined cycle and to compute an assumed road surface friction coefficient by
collating the vehicle speed Sv and acceleration obtainable by differentiating the
vehicle speed Sv with a data map, pre-stored in a built-in memory, indicating and
defining the relationship among the vehicle speed, acceleration and road surface
friction coefficient. By collating the assumed road surface friction coefficient with
a data map, pre-stored in a built-in memory, indicating and defining the relationship
between the road surface friction coefficient and a basic target slip value, there are
given a first basic target slip value for the traction control by adjusting the
opening angle of the secondary throttle valve and a second basic target slip value for
the traction control by controlling the brakes. Further, a first target slip value STT
for the traction control by adjusting the opening angle of the secondary throttle
valve is given and set by multiplying the first basic target slip value with a
correction coefficient on the basis of each vehicle speed indicated by the output
signal Sv, the depressed amount of the accelerator pedal indicated by the output
signal Sa and the steered angle indicated by the output signal Sd. Furthermore, a
second target slip value STB for the traction control by controlling the brakes is
given and set by multiplying the second basic target slip value with a correction
coefficient on the basis of each of the vehicle speed indicated by the output signal
Sv, the depressed amount of the accelerator pedal indicated by the output signal Sa
and the steered angle indicated by the output signal Sd. It is then to be noted that
the second target slip value STB is set to be larger than the first target slip value
STT.

WEST

☐ | Generate Collection | | Print |

L14: Entry 50 of 168   File: USPT   Sep 8, 1998

DOCUMENT-IDENTIFIER: US 5804935 A
TITLE: Drive system for electric vehicles

Abstract Text (1):
A dual-rotor electric motor (1), having an outer rotor (3) and an inner rotor (4),
drives a first drive axle (5) and a second drive axle (6), while also provides
inter-axle speed differential function. One of the drive axles is also a steering
axle. Torque and rotation are transmitted between the outer rotor and the first drive
axle through a clutch (19) and a first drive shaft (20), and between the inner rotor
and the second drive axle through a second drive shaft (22). A first brake (24) brakes
the rotation of the outer rotor, and a second brake (25) brakes the rotation of the
inner rotor. A fluid pressure source, including a pump (51) and an accumulator (59),
provides fluid pressure, through a plurality of fluid lines, for operating the clutch
and brakes. Electromagnetic control valves (60, 61, 62) control the operation of the
clutch and brakes. An electronics (78) monitors and compares continuously the
rotational speeds of the axles and controls the valves for engaging the clutch and
releasing the first brake when a speed lower than a predetermined value is detected,
whereby providing low-speed/four-wheel-drive mode, or disengaging the clutch and
applying the first brake when a speed higher than a predetermined value is detected,
whereby providing high-speed/two-wheel-drive mode, or applying the first brake or the
second brake when a traction slip respectively of the first drive axle or of the
second drive axle higher than a respective predetermined value is detected, whereby
providing anti-slip traction control.

Brief Summary Text (11):
Vehicle electronics, well known in the art, are capable to monitor continuously,
through appropriate sensors, the rotational speed of the vehicle wheels or the
rotational speed of the input shafts of the drive axles, as well as the rotational
speed of other drive train components or other variable parameters, related to the
rotational speed of the vehicle wheels, such as the steering angle of the vehicle
steering wheels. Such an electronics processes the signals from several sensors, and,
in accordance with a predetermined program, controls the operation of means whose
quick reaction is of utmost importance for the performance and safety of the vehicle.
For example, the electronics may control the performance of the engine of the vehicle,
or an automatic gear-shift transmission, or an anti-lock braking system, or an
anti-slip traction control system, or another system or combination of systems.
Therefore, it will be beneficial if such an electronics may be incorporated in the
design of an electric vehicle for providing automatic control of the drive system, in
accordance with the rotational behavior of the drive axles and a predetermined
program, and thus securing better performance and safety of the vehicle.

Brief Summary Text (16):
Yet another object of this invention is to provide the drive system with capability to
automatically restrict the traction slip of the vehicle wheels, therefore said drive
system also comprising a second brake for braking the rotation of said inner rotor,
means operating said second brake, and an electronics arranged and programmed to
monitor and compare continuously the rotational speeds of said first and second drive
axles and to control said means operating the first brake and said means operating the
second brake for applying the first brake when a traction slip of the first drive axle
higher than a predetermined value is detected or applying the second brake when a
traction slip of the second drive axle higher than a predetermined value is detected.

Detailed Description Text (16):
The electronics 78 is arranged to monitor and compare continuously the rotational speeds of the two drive axles 5, 6. When the drive system is in low-sped/four-wheel-drive mode, the electronics 78 may detect a significant traction slip of the wheels 7, 8 of the first drive axle 5, or a significant traction slip of the wheels 9, 10 of the second drive axle 6. Such a traction slip is demonstrated by a sudden acceleration of the rotation of the input shaft of the drive axle with poor traction in reference to the rotation of the input shaft of the drive axle with better traction. However, if a traction slip of the first drive axle 5 higher than a predetermined value is detected, the electronics 78, being so programmed, will energize the first brake control valve 61, and thus will apply the firsts brake 24. Then the braking torque produced by the first brake 24 will reduce the rotational speed of the spinning wheels 7, 8 of the first drive axle 5. By the same manner, if a traction slip of the second drive axle 6 higher than a predetermined value is detected, the electronics 78, being so programmed, will energize the second brake control valve 62, and thus will apply the second brake 25. Then the braking torque produced by the second brake 25 will reduce the rotational speed of the spinning wheels 9, 10 of the second drive axle 6. When one of the two brakes is applied, the torque transmitted to the axle having better traction will increase with the value of the applied braking torque, and eventually the four-wheel traction will be restored. When the drive system is in high-speed/two-wheel-drive mode, only the wheels 9, 10 of the second drive axle 6 can experience traction slip. In such a case, the electronics 78 will apply the second brake 25, and the braking torque of the second brake 25 will reduce the rotational speed of the spinning wheels 9, 10 of the second drive axle 6 until the traction is restored. Once the difference between the rotational speeds of the input shafts 21, 23 of the first and second drive axles 5, 6 is reduced below a predetermined value, i.e., once the traction is restored, the electronics 78, being so programmed, will disenergize the respective brake control valve, and thus will discontinue the automatic braking action of the brake, which has been applied automatically for reducing the traction slip.

CLAIMS:

8. A drive system according to claim 7, wherein said means for anti-slip traction control are electrically controllable means operating the first brake, electrically controllable means operating the second brake, and an electronics arranged and programmed to monitor and compare continuously the rotational speeds of said first and said second drive axles and to control said means operating the first brake and said means operating the second brake for applying the first brake when a traction slip of the first drive axle higher than a predetermined value is detected or applying the second brake when a traction slip of the second drive axle higher than a predetermined value is detected.

WEST

☐ | Generate Collection | | Print |

L13: Entry 2 of 12   File: USPT   Jun 4, 2002

DOCUMENT-IDENTIFIER: US 6398318 B1
TITLE: Method and device for monitoring a braking system contained in a vehicle

Brief Summary Text (2):
International Patent Publication No. WO 97/21570 describes a conventional braking
system. This conventional braking system has a master brake cylinder, to which wheel
brake cylinders are connected via wheel-brake pressure-modulation valve arrangements
having a brake-pressure build-up valve and a brake-pressure reducing valve. Brake
fluid released from the wheel brake cylinders through the brake-pressure reducing
valves can be delivered by a return pump back in the direction of the master brake
cylinder, or in the direction of the wheel brake cylinders again for renewed pressure
build-up. A precharging pump is used to feed brake fluid from a reservoir to the
return pump when the master brake cylinder is not actuated. Given appropriate
switching of valves in the known vehicle braking system, brake pressure can be built
up in the vehicle braking system both by the return pump and by the precharging pump.
Furthermore, for slip control, this vehicle braking system has wheel-rotation sensors
as well as an electronic controller which evaluates signals from the wheel rotation
sensors and controls the pumps and valves of the vehicle braking system. This
conventional vehicle braking system has a brake-slip control, traction-control, and an
operating-dynamics control device.

Brief Summary Text (5):
German Patent Application No. 39 22 947 describes a hydraulic braking system which
contains brake-pressure modulators that make it possible to prevent the vehicle wheels
from locking as a result of brake pressures which are too high. The brake-pressure
modulators include brake-line lock valves and cylinders having pistons, in response to
whose displacement, pressurized media escapes from the wheel brakes to reduce the
brake pressure. The piston displacements are controlled via valve configurations which
are connected to a servo pressure source. Failure of the servo pressure source, if
there is even a small leak of a valve arrangement, can lead to at least partial loss
of braking force during a braking operation. To detect and indicate possibly existing
leakiness, a control unit, acting on the valve arrangements, is adjusted, such that it
controls the valve arrangements into different positions, and at the same time,
observes via a pressure sensor whether logically assigned pressures are changing
unacceptably. This conventional braking system also has the disadvantage that pressure
sensors are necessary to implement the monitoring. It may be that it is possible to
monitor the braking system independently of the driver, however the braking medium
necessary for this is made available starting from a storage reservoir. Because of
this, a constant pressure of the braking medium is not absolutely ensured, which can
possibly lead to an impairment of the implemented monitoring.

Brief Summary Text (12):
Since the braking system is monitored as a function of a wheel-performance variable,
the method according to the present invention therefore advantageously proceeds during
predetermined vehicle states. This ensures that the wheel-performance variable, and
with this variable the monitoring or checking of the braking system as well, is not
invalidated by the vehicle performance. For example, the wheel-performance variable
could be invalidated in response to cornering, or during an acceleration or braking
process. To avoid this, the predetermined vehicle states are can be defined as
follows: A predetermined vehicle state exists when the vehicle is traveling
approximately straight ahead (e.g., in a straight line), and a variable describing the
vehicle velocity is nearly constant, i.e., the vehicle is being neither braked nor

accelerated, and the master brake cylinder is not actuated. Actuation of the master brake cylinder can be ascertained, e.g. with the aid of a brake lights switch. Such vehicle states can be brought about either intentionally, or can arise during the operation of the vehicle, i.e., during normal vehicle operation. As an example, the control at the rear end of the assembly line at the vehicle manufacturer, during which the vehicle is either moved by a driver according to defined stipulations or the vehicle is on a roller dynamometer, or a test drive after being in a service garage, could be named as intentionally caused vehicle states.

Brief Summary Text (14):
All the intake valves can be brought by the predefined driving signals into a blocking position during this check test. During this driving of the intake valves, braking medium is conveyed toward the intake valves by actuating the pump. If the intake valves are in perfect condition, i.e. if in the blocking position, they in each case completely close off the associated wheel brake cylinder, then the brake pressure in the respective associated wheel brake cylinder cannot increase. On the other hand, if the intake valves do not completely close, then the brake pressure in the respective associated wheel brake cylinder will increase, which leads to a change in the associated wheel-performance variable. To better be able to ascertain the increase in brake pressure because of a defective intake valve, all the second valves of the first valve configurations, e.g., all discharge valves, can be also brought by the predefined driving signals into a blocking position. This ensures that the braking medium, which has flowed into the wheel brake cylinder, does not immediately flow out of the wheel brake cylinder again.

Brief Summary Text (15):
The check test for the first fault can be performed as follows: During the appropriate driving of the first and second valves of the first valve configurations, a wheel-performance variable is ascertained for each wheel. These wheel-performance variables are compared to a threshold value. If all the wheel-performance variables are less than the threshold value, which is synonymous with the brake pressure not having risen in the wheel brake cylinders, and the intake valves therefore being impervious, then the first fault is not present. In the event that at least one of the wheel-performance variables is greater than the threshold value, which is an indication that the first fault seems to be present, the driving of the pump and of the first and second valves is stopped.

Brief Summary Text (19):
Since the intention during this check test is to ascertain whether the wheel brake cylinders are correctly connected to the hydraulic modulator, i.e., the braking system, or whether the wheel r.p.m. sensors are correctly connected to the controller, to this end, for a first valve configuration, the predefined driving signals advantageously bring the first valve into a flow-through position and the associated second valve into a blocking position, and for the remaining first valve configurations, the first valves are brought into a blocking position, and the associated second valves are brought into a blocking position or a flow-through position. During the above-described driving of the first and second valves, braking medium is conveyed in the direction of the wheel brake cylinders by actuating the pump. Due to the above-described driving, one wheel brake cylinder is acted upon by the brake pressure built up by the pump, however the brake pressure does not act on the remaining wheel brake cylinders. Preferably, the discharge valves of these remaining wheel brake cylinders are open, to ensure that the brake pressure does not act on these wheel brake cylinders. The one wheel brake cylinder is acted upon by a brake pressure which is sufficient to bring about a noticeable change in the wheel-performance variable of the corresponding vehicle wheel, i.e., the r.p.m. or velocity of this vehicle wheel decreases significantly. No build-up in brake pressure can take place in the case of the remaining wheel brake cylinders, and thus no change can occur in the wheel-performance variable either.

Brief Summary Text (22):
The check test for the second fault can also be performed in such a way that, in each case, the associated first valve is brought appropriately into the flow-through position for a different wheel, one after the other. In other words, the check test for the second fault is performed so that, due to the cyclical driving of the first valve configurations, the brake pressure can act upon each vehicle wheel one time

during a test cycle. In so doing, sufficient time is provided in each case after the cyclical driving, so that the <u>brake pressure</u> of the respective wheel acted upon with pressure can again normalize.

<u>Brief Summary Text</u> (25):
The method according to the present. invention can be implemented on single-circuit braking systems, just as on multiple-circuit braking systems. This method can also be implemented for hydraulic and for pneumatic braking systems. Furthermore, the method according to the present invention can be implemented for electrohydraulic or electropneumatic braking systems, in which the <u>brake pressure</u> is not built up by a master brake cylinder, but by a pump or by a compressor, and is controlled as a function of a brake-force signal caused by a brake pedal. The method according to the present invention can also be implemented in the case of multiple-circuit braking systems having a precharging pump for each brake circuit.

<u>Detailed Description Text</u> (4):
Master brake cylinder 14 is designed, in a conventional manner, as a dual-circuit master brake cylinder. Master brake cylinder 14 has a first "rod piston" 36 which is moved directly by brake pedal 30 via power brake unit 32. In response to its displacement into master brake cylinder 14, rod piston 36 causes a build-up of <u>brake pressure</u> in a first pressure chamber 38 of master brake cylinder 14. In addition, master brake cylinder 14 has a second "floating piston" 40 which is acted upon by the pressure in first pressure chamber 38 and is thereby shifted in master brake cylinder 14 and, in response to its displacement into master brake cylinder 14, produces a <u>brake pressure</u> in a second pressure chamber 42 of master brake cylinder 14. The two pistons 36, 40 are indicated in the drawing by dotted lines. If, because of a defect, no <u>brake pressure</u> is built up in first pressure chamber 38 in response to the shift of rod piston 36 into master brake cylinder 14, rod piston 36, after a free travel, mechanically shifts floating piston 40 in a conventional manner, so that <u>brake pressure</u> is built up in second pressure chamber 42 by stepping down on brake pedal 30.

<u>Detailed Description Text</u> (9):
On an intake side of return pump 66, a pressure accumulator 74 is connected to feedback line 60. In feedback line 60, a check valve 76, traversable by flow in the direction of return pump 66, is arranged between pressure accumulator 74 and the intake side of return pump 66. A damper chamber 78 is disposed in feedback line 60 between a delivery side of return pump 66 and main brake line 44. An intake line 80 is connected directly to master brake cylinder 14 via main brake line 44, thus bypassing switch-over valve 48, a suction valve 82, closed in its basic position (e.g., blocking position), being arranged in intake line 80. The suction valve represents a second valve on the intake side. Intake line 80 leads to the intake side of return pump 66. Intake line 80 is used to feed brake fluid under pressure to return pump 66 in the event master brake cylinder 14 is not actuated, in order to achieve rapid <u>brake-pressure</u> build-up, even when working with cold, viscous brake fluid. The pressure is built up by a first pump (e.g., a precharging pump) 84 which is able to be driven by a separate electromotor 86, is connected to brake-fluid reservoir 28 of master brake cylinder 14 and delivers the brake fluid via a check valve 88 into main brake line 44 of a brake circuit I, with main brake line 44 being connected to first pressure chamber 38 of master brake cylinder 14. Precharging pump 84 acts with pressure upon first pressure chamber 38. In the event master brake cylinder 14 is not actuated, first pressure chamber 38 communicates via a restrictor, not shown in FIG. 1, with reservoir 28.

<u>Detailed Description Text</u> (10):
In master brake cylinders 14, the restrictor is formed by a central valve in rod piston 36, or a snifting bore hole, not shown in FIG. 1, in the connection of first pressure chamber 38 to reservoir 28. Thus, when master brake cylinder 14 is not actuated, precharging pump 84 conveys brake fluid in the circuit from reservoir 28 into first pressure chamber 38 and via the restrictor back into reservoir 28. Because of the restrictor, a pressure build-up takes place in first pressure chamber 38, and thus in main brake line 44. Because pressure acts upon first pressure chamber 38, pressure also acts upon second pressure chamber 42 via floating piston 40 of master brake cylinder 14, so that a pressure build-up also takes place in second brake circuit II. Given a closed switch-over valve 48 and an open (flow-through position)

suction valve 82, as a result of the pressure build-up by precharging pump 84, a portion of the brake fluid delivered by precharging pump 84 flows to the intake side of return pump 66, in order to effect the rapid brake-pressure build-up by return pump 66.

Detailed Description Text (14):
To determine whether the vehicle is in a predetermined state, a variable vf describing the vehicle velocity is ascertained in a conventional manner in block 202 as a function of wheel r.p.m. variables nij. With the aid of variable vf, it is determined whether the vehicle velocity is nearly constant. For example, the change of variable vf over time is determined and is compared to a corresponding threshold value. It is simultaneously ascertained in block 202 whether the vehicle is traveling approximately straight. To detect this straight-line travel, there are various possibilities as a function of the slip control carried out by block 204, which represents the controller core. For example, the difference between the wheel r.p.m. variables of wheels having the same axle is determined, in particular the front wheels. To determine whether the vehicle is traveling straight, the difference is compared to a corresponding threshold value. However, in this case, an additional logic is necessary for monitoring the wheel r.p.m. sensors, in order to detect or rule out possible errors which can originate from the wheel r.p.m. sensors. This detection of straight-line travel presents itself primarily when a brakeslip and/or traction control is being carried out in the controller core. Alternatively, and above all when an operating-dynamics control is being carried out by the controller core, and thus the relevant sensor 26 is available, a steering-angle signal delta and/or a transversal-acceleration signal aq and/or a yaw-rate signal omega can be evaluated to ascertain the straight-line travel. This is shown in FIG. 2 by the dotted-line representation and link of block 26 to block 202. A predetermined vehicle state exists when the vehicle velocity is nearly constant, and the vehicle is traveling approximately straight ahead. It can also be required that the master brake cylinder not be actuated.

Detailed Description Text (19):
Subsequently to step 302, a step 303 is carried out. In this step, wheel-slip variables lambdaij are ascertained in known manner for the vehicle wheels, on the basis of wheel r.p.m. variables nij and variable vf. Following step 303, a step 304 is executed, in which wheel-slip variables lambdaij are compared to a threshold value S. If it is determined in step 304 that one of wheel-slip variables lambdaij is greater than threshold value S, which is synonymous with an intake valve being defectively open, then, subsequently to step 304, a step 305 is carried out. If, on the other hand, it is determined in step 304 that no wheel-slip variable is greater than the threshold value, which is synonymous with all the intake valves being perfect, then, subsequently to step 304, a step 308 is executed. Therefore, in step 308, the value FALSE is assigned to variable F1. Following step 308 is a step 309, which terminates the check test for the first fault.

Detailed Description Text (20):
In step 305, first the driving initiated in step 302 is broken off. After a predefined period of time, pump 66 and/or pump 84, as well as valves 48, 54, 56, 62, 64 and 82 are driven once more in accordance with step 302. In addition, wheel-slip variables lambdaij are ascertained once again. Subsequently to step 305, a step 306 is carried out. In this step, wheel-slip variables lambdaij are compared once again to a corresponding threshold value, as has already taken place in step 304. If it is determined in step 306 that one of wheel-slip variables lambdaij is greater than threshold value S, then subsequently to step 304, a step 307 is executed. Since at least one of the intake valves is defective, in this step, the value TRUE is assigned to variable F1. Following step 307, step 309 is carried out. If, on the other hand, it is determined in step 306 that no wheel-slip variable is greater than the threshold value, then subsequently to step 306, step 308 is executed.

CLAIMS:

19. A method for monitoring a braking system disposed in a vehicle, the braking system including at least one brake circuit, the at least one brake circuit having an output side and including valve configurations on the output side,.the vehicle including wheel brake cylinders allocated to the at least one brake circuit and connected to the valve configurations, the braking system further including at least one pump for

delivering a braking medium to at least two cylinders of the wheel brake cylinders, the method comprising the steps of:

(a) during predetermined vehicle states, actuating the at least one pump, and driving the valve configurations using predetermined driving signals;

(b) determining a wheel-performance variable for at least one wheel of the vehicle during step (a), the wheel-performance variable indicating a wheel performance of the at least one wheel; and

(c) checking, as a function of the wheel-performance variable, whether at least one of a first fault and a second fault of the braking system has occurred;

wherein, during a check for the first fault, the wheel-performance variable is a wheel-slippage variable which indicates a wheel slippage of the at least one wheel;

wherein, during a check for the second fault, the wheel-performance variable is a wheel-velocity variable which indicates one of a wheel revolutions-per-minute (r.p.m.) and a velocity of the at least one wheel; and

wherein, during step (c), the predetermined vehicle states are present when the vehicle is traveling in an approximately straight path and when a velocity variable indicating a velocity of the vehicle is substantially constant.